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Education Department Bulletin

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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 152

GEOLOGY OF THE HONEOYE-WAYLAND QUADRANGLES

BY

D. DANA LUTHER

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1911

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New York State Education Department
Science Division, December 2, 1910

Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I have the honor to transmit to you herewith and to recommend for publication as a bulletin of the State Museum a manuscript report and map covering the geology of the Honeoye and Wayland quadrangles of the geological map of the State, which have been prepared by Mr D. Dana Luther, of this staff.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 2d day of December 1910

Commissioner of Education

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New York State Museum

John M. Clarke, Director

Museum Bulletin 152

GEOLOGY OF THE HONEOYE–WAYLAND QUADRANGLES

By D. Dana Luther

The Honeoye-Wayland quadrangles are included between the lines of latitude 42° 30′ and 43° north, and of longitude 77° 30′ and 77° 45′ west and contain one-eighth of a degree, or about 441 square miles of territory.

The rocks of these quadrangles have an estimated aggregate thickness of about 2660 feet, of which 1510 feet are surface rocks because of the difference in altitude between the lowest outcrop, which is on Honeoye creek near Sibleyville at 590 feet A. T., and the highest, at the top of Sand hill near the south line of the Wayland quadrangle at 2100 feet A. T. Eleven hundred and fifty feet of strata are brought to the surface by their elevation toward the north at an average rate of about 33 feet per mile.

These rocks embrace the following geological subdivisions or formations, twenty-four in number, which are represented by distinctive colors on the accompanying map.

Devonic	Senecan	Chemung shale and sandstone
		Wiscoy shale
		Nunda sandstone
		Gardeau flags and shale
		Grimes sandstone
		Hatch shale and flags
		Rhinestreet black shale
		Cashaqua shale
		Middlesex black shale
		West River shale
		Genundewa limestone
		Genesee black shale
		Pyrite layer. Tully horizon
	Erian	Moscow shale
		Tichenor limestone
		Ludlowville shale
		Skaneateles shale
		Cardiff shale
		Stafford limestone
		Marcellus black shale
	Ulsterian	Onondaga limestone
	Oriskanian	Oriskany sandstone
Ontaric or Siluric	Cayugan	Bertie waterlime
		Camillus shale

FORMATIONS IN ASCENDING ORDER

ONTARIC OR SILURIC

CAMILLUS SHALE

The drift hills on the northern border of the Honeoye quadrangle rest upon thin magnesian limestones and soft gypseous shales belonging to this formation, which receives its name from the town of Camillus, Onondaga county, where the first discovery of gypsum in the United States was made in the year 1792, and where the beds of this formation are abundantly exposed.

The Camillus strata are entirely covered on these quadrangles, but are exposed at Victor on the Canandaigua quadrangle and at Wheatland and Garbuttsville on the Brockport quadrangle.

BERTIE (AND COBLESKILL?) WATERLIME

The Camillus shales are succeeded by 85 to 100 feet of waterlimes varying in character from hard, flaggy layers to beds of soft dolomite in which lines of deposition are very obscure. At the top of this formation, in the vicinity of Honeoye Falls, there are exposed 35 feet of waterlime, of which 3 feet 6 inches at the top are in uneven layers 2 to 6 inches thick and break easily into small rough blocks. It is quite probable that this stratum, which somewhat resembles the "bullhead" of Erie county, should be correlated as Cobleskill waterlime, but no fossils are found in it.

Next below these are 20 feet of hard waterlimes showing faint lines of bedding. Some parts have no regular fracture. In this vicinity, this bed has been quarried quite largely for building purposes.

The underlying ten feet of rock are flaggy and at one or two horizons quite shaly. The lower beds are generally softer, and in some parts shaly, but there are thin hard layers separated by thin partings of black bituminous matter and heavier strata of softer waterlimes that have no regular fracture. The contact with the Camillus shales is not exposed on this quadrangle.

The waterlimes are exposed along the Hemlock outlet in the village of Honeoye Falls below the milldam east of the high school building, and along the stream to below the Lehigh Valley Railroad bridge. There are quarries in the upper beds east and west of the south end of this bridge, where the contact with the Oriskany horizon also appears. There are good exposures of forty feet of the upper beds along Spring creek two miles west of Honeoye Falls, and in the large old quarry one-fourth of a mile south of the New York Central Railroad bridge over this stream.

There is a small exposure of waterlime near an old limekiln one and one-half miles west of Spring creek with the Onondaga limestone five feet higher, and small outcrops of this rock occur in the bed of Stony brook at Five Corners.

In the central part of the State and in Erie county the waterlime beds contain fossils of several species, but the strata exposed on this quadrangle are almost barren. Leperditia alta (Conrad) and Whitfieldella laevis (Whitfield) are the only forms observed.

In the salt shaft near Livonia on the Honeoye quadrangle the following fossils were found in these beds:

Spirifer vanuxemi *Hall*
Stropheodonta varistriata (*Conrad*)
Liopteria rugosa *Hall*
Leperditia alta (*Conrad*) and a small Favosites

DEVONIC

ORISKANY SANDSTONE

This formation is represented here by eight inches of gray calcareous sandstone containing no fossils. It is exposed in the rock wall along Hemlock outlet at the dam east of the high school at 634 A. T. in Honeoye Falls and also at the south end of the Lehigh Valley Railroad bridge one-half mile northwest of the village. In the Livonia salt shaft there were at this horizon five feet of coarse, green and gray conglomerate containing eight species of brachiopods, suggestive of a commingling of the faunas of the Oriskany sandstone and Schoharie grit of the eastern part of the State. They are

Pentamerella *cf.* arata (*Conrad*)
Atrypa reticularis (*Linné*)
Orthis *cf.* propinqua (*Hall*)
Hipparionyx proximus *Vanuxem*
Stropheodonta *sp.*
Pentagonia unisulcata (*Conrad*)
Spirifer *cf.* arenosus *Conrad*

ONONDAGA LIMESTONE

The Onondaga limestone is composed of layers or tiers of blue gray limestone, separated by partings of dark shale or black bituminous matter.

Dark chert or impure flint in nodules or nodular layers is unevenly distributed throughout nearly the entire formation, but is in larger proportion in the lower part, except for an uneven stratum two to five feet thick at the base, which is largely composed of corals and from which chert is absent.

The cherty lower beds supply the material for the crushed stone used in roadmaking and for ballast, while the basal stratum and the layers clear from chert found in the upper part of the formation furnish an inexhaustible supply of valuable building stone and quicklime.

The entire section of this formation is exposed along Honeoye creek from the Monroe milldam in Honeoye Falls to the north side of the bend half a mile south of North Bloomfield, except for a small hiatus in the middle of the formation between the two villages. The lower beds may be seen along the bed of Spring creek and the upper tiers in the quarry of the Genesee Lime Company two miles southwest of Honeoye Falls. The basal layer, specially rich in corals, outcrops over an area of half an acre near an old limekiln three miles west of Honeoye Falls near a north and south road one and one-eighth miles west of Spring creek. Some of the lower tiers outcrop in the road south of Five Corners, and there are several field outcrops farther south in the region drained by Stony brook.

The fauna of the Onondaga limestone is very large; a list of species found in this formation, given in State Museum Bulletin 63, contains 3 fishes, 39 crustaceans, 13 cephalopods, 3 pteropods, 38 gastropods, 15 lamellibranchs, 48 brachiopods, 4 crinoids and 30 corals; total 193.

MARCELLUS BLACK SHALE

The blue Onondaga limestone is succeeded by black, carbonaceous shales and soft, dark impure limestones to the thickness of 41 feet in the Livonia salt shaft but somewhat thinner on the line of outcrop. On these quadrangles this shale is terminated at the top by the Stafford limestone, and it constitutes the lower division of the "Marcellus shale," as described by Hall and Vanuxem.

The lower beds are mostly calcareous and fossiliferous, while the upper are composed mainly of densely black bituminous and pyritiferous shale in which occur spherical concretions six inches to one foot, six inches in diameter.

This formation is rich in hydrocarbons and is the source of the natural gas produced by the shallower gas wells of this region. Many of the concretions are septaria and the cavities within them occasionally contain a small quantity of petroleum. On account of the compact character of this rock, gas wells terminating in it are not very productive except when a crevice or large pocket is penetrated. Fossils are abundant, specially in the lower more calcareous part on this formation.

The following species were found in the Marcellus shale and limestone in the Livonia salt shaft, in the upper black shale and concretions:

Plates of Aspidicthys and Dinichthys halmodeus (*Clarke*)
Orthoceras nuntium *Hall*
O. subulatum *Hall*
Tornoceras uniangulare (*Conrad*)
Cyrtoceras citum *Hall*
Pleurotomaria rugulata *Hall*
Styliolina fissurella *Hall*
Panenka lincklaeni *Hall*
P. equilatera *Hall*
Nuculites nyssa *Hall*
Pterochaenia fragilis (*Hall*)
Liopteria laevis *Hall*
Pterinopecten dignatus *Hall*
Actinopteria muricata *Hall*
Orbiculoidea minuta *Hall*
Liorhynchus limitare (*Vanuxem*)
Chonetes mucronatus *Hall*

The following additional species occur in the more calcareous beds near the base of the formation:

Phacops rana *Green*
Orthoceras incarceratum *Clarke*
O. lima *Hall*
Tentaculites gracilistriatus *Hall*
Pleurotomaria lucina *Hall*
Aviculopecten *cf.* fasciculatus *Hall*
Modiomorpha subalata (*Conrad*)
M. concentrica *Hall*
Cypricardinia indenta (*Conrad*)
Microdon bellistriatus (*Conrad*)
Nuculites oblongatus *Conrad*
Palaeoneilo plana (*Conrad*)
Tropidoleptus carinatus (*Conrad*)
Spirifer audaculus *Conrad*
Ambocoelia umbonata (*Conrad*)
A. praeumbona *Hall*
Athyris spiriferoides (*Eaton*)
Coelospira camilla *Hall*
Terebratula *sp.*
Stropheodonta inequistriata (*Conrad*)
Leptostrophia perplana (*Conrad*)

Orthothetes pandora *Hall*
O. bellulus *Clarke*
Orthis *cf.* lenticularis *Hall*
Chonetes deflectus *Hall*
C. lineatus (*Conrad*)
C. *cf.* yandellanus *Hall*
Pholidops hamiltoniae *Hall*
Stictopora incisurata *Hall*
Stereolasma rectum *Hall*

The Marcellus beds are covered on this quadrangle except for a small exposure under the Erie Railroad bridge over Little Conesus creek a mile south of Avon.

STAFFORD LIMESTONE

This formation takes its name from Stafford, Genesee county, where it is well exposed. It is eight feet three inches thick at Lancaster, Erie county, but diminishes gradually toward the east, and at its extreme eastern exposure on Flint creek, Ontario county, is but four inches thick.

On this quadrangle it is a hard blue limestone, in one stratum 14 to 18 inches thick with a few inches of calcareous shale above and below.

There are no exposures of the Stafford limestone on these quadrangles but it may be seen below the second dam on Conesus outlet west of Ashantee, and in the bed of Little Conesus creek east of the Erie Railroad bridge.

The Stafford limestone is rich in fossils at every exposure and a list published in State Museum Bulletin 49 contains the names of 118 species which have been collected from it. This stratum occurs in the Livonia salt shaft at the depth of 823 feet and contained the following forms:

Phacops rana *Green*
Orthoceras aedipus *Hall*
O. *cf.* marcellense *Hall*
Loxonema delphicola *Hall*
Pleurotomaria sulcomarginata (*Conrad*)
P. itys *Hall*
P. lucina *Hall*
Meristella barrisi *Hall*

Camarotoechia sappho *Hall*
C. horsfordi *Hall*
Chonetes scitulus *Hall*
C. mucronatus *Hall*
Strophalosia truncata *Hall*
Ambocoelia umbonata (*Conrad*)
Orthothetes arctostriatus *Hall*
Spirifer subumbona *Hall*
S. audaculus (*Conrad*)
Atrypa recticularis *Linné*
Panenka lincklaeni *Hall*
P. aequilatera *Hall*
Pterinopecten exfoliatus *Hall*
Actinopteria muricata *Hall*
Aviculopecten bellus *Conrad*
Styliolina fissurella *Hall*

CARDIFF SHALE

The shales succeeding the Stafford limestone and formerly known as upper Marcellus, are richly bituminous, though in a somewhat less degree than those below, for about sixty feet gradually becoming more argillaceous and lighter colored, and passing into the next higher formation.

The only exposure of the Cardiff shale on this quadrangle is along Little Conesus creek between the Erie Railroad bridge and the Avon reservoir. In the Livonia shaft section these beds were penetrated at 753 to 823 feet and the following species were found in them:

Tornoceras uniangulare (*Conrad*)
Orthoceras subulatum *Hall*
O. nuntium *Hall*
Cyrtoceras *sp.*
Pleurotomaria rugulata *Hall*
P. capillaria (*Conrad*)
Bellerophon leda *Hall*
Liopteria laevis *Hall*
Modiella pygmaea (*Conrad*)
Pterochaenia fragilis (*Hall*)
Actinopteria muricata *Hall*
Buchiola retrostriata *v. Buch*
Actinopteria (small) *sp.*
Panenka lincklaeni *Hall*

Pterinopecten dignatus *Hall*
Nuculites triqueter *Conrad*
Modiomorpha *cf.* subalata (*Conrad*)
Liorhynchus limitare *Vanuxem*
Productella spinulicosta *Hall*
Strophalosia truncata *Hall*
Orbiculoidea minuta *Hall*
Styliolina fissurella *Hall*
Reptaria stolonifera *Rolle*

SKANEATELES SHALE

This formation is a bed of soft dark clayey shales quite bituminous and pyritiferous in some parts and containing fossils but sparingly, though a few thin calcareous lentils are composed almost entirely of compressed shells.

It is 145 feet thick and is terminated at the top by a stratum of hard calcareous sandy shale containing cyathophylloid corals in abundance.

Skaneateles shale is exposed along Little Conesus creek below the Avon reservoir, but is not seen elsewhere on these quadrangles.

Its place in the Livonia shaft section is 608 to 753 feet below the top.

The following fossils occur in these beds:

Phacops rana *Green*
Cryphaeus boothi *Green*
Tornoceras uniangulare (*Conrad*)
Orthoceras exile *Hall*
Gomphoceras *sp.*
Pleurotomaria rugulata *Hall*
Bellerophon leda *Hall*
Pterochaenia fragile (*Hall*)
Liopteria laevis *Hall*
Panenka equilatera *Hall*
Palaeoneilo fecunda *Hall*
Orthonota undulata *Conrad*
Chonetes scitulus *Hall*
C. lepidus *Hall*
C. mucronatus *Hall*
Liorhynchus multicostum *Hall*
L. limitare (*Vanuxem*)
Styliolina fissurella *Hall*
Crinoid stems

LUDLOWVILLE SHALE

This formation consists of beds of shale varying in character from black and bituminous to light colored sandy and calcareous. Calcareous concretions are quite common, and 65 feet above the base and near the top there are even layers of limestone one to two feet thick.

The Ludlowville shale is terminated at the top by the Tichenor limestone.

The basal hard layer, which is a coral reef at Centerfield, Ontario county, and a calcareous sandstone in the Livonia shaft section, is exposed at an old mill site on Little Conesus creek near the Avon reservoir, but is almost entirely devoid of fossils.

Along Gates creek two miles north of Allens Hill 15 to 20 feet of the shales next below the Tichenor limestone are exposed.

This formation was named from its exposure along the shore of Cayuga lake near Ludlowville, Tompkins county. It extends across central and western New York and is everywhere richly fossiliferous. Lists of the fossils composing its fauna may be found in volume 1 of the Report of the State Geologist for 1893 and in State Museum Bulletin 63.

TICHENOR LIMESTONE

A stratum of limestone about one foot in thickness overlies the Ludlowville shale from Cayuga county to Lake Erie. It was known by the geologists of the early State Survey as the Encrinal limestone and serves as a bench mark in the stratigraphy of the western part of the State. The name Encrinal limestone was applied to the stratum on account of the abundance of crinoid fragments which it contains and of which it is, at some localities, almost entirely composed.

A calcareous stratum of somewhat similar appearance to the Tichenor limestone which occurs at the base of the Ludlowville shale and outcrops at Centerfield on the Canandaigua quadrangle, on the Attica quadrangle and other places in western New York, has sometimes been erroneously identified as the Encrinal, hence a more specific name has proved desirable. The favorable exposure in Tichenor gully on the west shore of Canandaigua lake suggested the present name. A small exposure on Gates creek near the old milldam is the only one on these quadrangles where Tichenor appears. The following is a partial list of the fossils that occur in it:

Phacops rana *Green*
Orthoceras caelamen *Hall*

Diaphorostoma lineatum (*Conrad*)
Lyriopecten orbiculatus *Hall*
Spirifer mucronatus *Conrad*
Sp. granulosus (*Conrad*)
Heliophyllum halli *Edwards & Haime*
Favosites argus *Hall*
F. arbusculus *Hall*
Eridophyllum *sp.*

Heads of Megistocrinus and other crinoids are sometimes found in the soft shale that immediately overlies the limestone.

MOSCOW SHALE

Succeeding the Tichenor limestones there are 147 feet of shale, in which calcareous concretions and thin calcareous lenses, composed largely of crinoid and other fossils, are common. The principal part of the shale is light bluish gray and quite calcareous, but at some horizons it is quite dark. Iron pyrite in nodules is common, specially in the upper beds and occasionally occurs in the shape of casts of small fossils.

East of Canandaigua lake the upper limit of this formation is the base of the Tully limestone which does not extend west of the town of Gorham, Ontario county, but in its place there is found at some exposures a thin layer of iron pyrite separating the blue Moscow shale from the black Genesee.

The upper part of the Moscow shale, with overlying pyrite layer and Genesee shale, is exposed along Hemlock creek south of Richmond Mills, and the base of the formation on Gates creek (sometimes called Beebe brook). Its place in the Livonia shaft section is 280 to 427 feet from the top.

This formation is very rich in fossils. For lists of species see 13th Report of the State Geologist, volume 1, 1893, and State Museum Bulletin 63.

PYRITE LAYER. HORIZON OF TULLY LIMESTONE

The formation ot hard limestone, named from its best development at Tully, Onondaga county, where it has a thickness of 28 feet, thins out toward the west and disappears on the east side of Canandaigua lake. Westward across the Canandaigua and Honeoye quadrangles lentils of iron pyrites from one to four inches thick and

two to ten rods across, occur in the horizon of the Tully limestone so frequently as to appear at nearly every exposure of the Moscow-Genesee contact. When freshly exposed the stratum is extremely hard and refractory, but it softens and disintegrates in very old exposures, its position in the walls of ravines being usually indicated by a thin rust-colored band.

Fossils of 48 species have been identified from this layer in Ontario and Livingston counties. A full description of the pyrite lentils and a list of its fossils may be found in State Museum Bulletin 69, 1903.

GENESEE BLACK SHALE

Overlying the pyrite layer or, in its absence, the Moscow shale, there is a bed of black bituminous shale similar in appearance to the Marcellus shale 500 feet lower in the strata. As commonly used, the term applied to these strata has included the succeeding Genundewa limestone, the dark West River shale and the black Middlesex shale above it. As here used, the term Genesee black shale designates the strata between the Tully horizon and the Genundewa limestone, which on these quadrangles have a total thickness of 85 to 90 feet. The shales are mostly densely black and contain a proportion of hydrocarbons sufficiently large to produce, when freshly broken, a natural fetid odor.

Pyrite in small nodules is common. Rows of spherical concretions and a few thin flags of fine grained calcareous sandstone, also occur.

Fossils, except a few plant remains, are almost entirely absent from the black shale and are rare in the lighter beds. The following have been obtained from the Genesee shale in this region:

Conodont teeth
Pleurotomaria rugulata *Hall*
Probeloceras lutheri *Clarke*
Bactrites aciculum (*Hall*)
Styliolina fissurella *Hall*
Pterochaenia fragilis (*Hall*)
Lingula spatulata *Hall*
Orbiculoidea lodensis *Hall*
Liorhynchus quadricostatus *Hall*

Exposures of Genesee shale may be found on the Honeoye quadrangle in two ravines on the east side of the valley two miles north of the village of Honeoye, along the Hemlock outlet one to

two miles north of Hemlock village, and in the ravine on the west side of Conesus lake near Eagle point.

GENUNDEWA LIMESTONE

This designation has been applied to a band of thin impure limestones separated by partings of a few inches or feet of black shale, the whole having a total thickness of six to eight feet.

Some of the limestone layers are very uneven and somewhat nodular, while others are even and compact; one of the latter, twelve to fourteen inches thick, has been utilized to a limited extent for building purposes.

The limestones are composed principally of the minute shells of the pteropod Styliolina fissurella Hall and the formation was formerly known as the "Styliola band." These shells give the limestone a sandy appearance after long exposure. This formation is exposed in two ravines two miles northeast of Honeoye and in the bed of Whetstone brook two miles northwest of Honeoye. It may be seen in a gully near the first bridge over the Hemlock outlet below Hemlock village, and in a larger ravine half a mile farther north. It appears fifty feet above the lake level in the ravine near Eagle point, Conesus lake.

Fossils are abundant in this formation, and the fauna is of peculiar interest owing to the appearance of many forms not known to occur in the rocks below.

A list of fossils numbering forty-eight species, obtained from the Genundewa strata, may be found in State Museum Bulletin 63.

WEST RIVER DARK SHALE

Succeeding the Genundewa limestones there are 65 to 75 feet of dark gray shale in which there are interstratified beds of black shale one to three feet thick, at intervals of three to eight feet, which, in walls of ravines, give this formation a broadly banded appearance. Calcareous concretions are common; some of these are septaria and have been known under the names "petrified turtles," "niggerheads" and others of similar character. A few thin flags of calcareous sandstone also occur.

At the top the passage to the succeeding black Middlesex shale is through several alternations of dark and black shale in a few feet.

The West River shales are exposed along Whetstone creek two miles northwest of Honeoye; in all the large ravines toward the

west to Hemlock lake; on Conesus lake in the ravines between Old Orchard point and McPherson point, on the east side, and between Eagle point and Long point on the west side.

Fossils are rare in the West River beds. A few individuals of the following species occur:

Bactrites aciculum (*Hall*)
Gephyroceras *sp.?*
Pleurotomaria rugulata *Hall*
Buchiola retrostriata *v. Buch*
Pterochaenia fragilis (*Hall*)
Lunulicardium curtum *Hall*
Panenka *sp.*
Lingula spatulata *Vanuxem*
Orbiculoidea lodensis *Vanuxem*
Melocrinus clarkei *Hall*

MIDDLESEX BLACK SHALE

A bed of black shale similar in appearance to the Genesee beds, succeeds the West River shales to the thickness of 30 to 35 feet. As the transition to the adjacent formations is gradual both above and below, the assigned thickness is somewhat arbitrary. It may be recognized beneath the lighter Cashaqua shale as far east as Cayuga county, where it ceases to be separable from the West River shale. Toward the west it is more distinctly differentiated from the adjacent formations and on the shore of Lake Erie it is a homogeneous band of black slaty shale six feet thick.

This formation is exposed in the ravines in the Honeoye Lake valley and in the region two miles south of Richmond Mills. It is finely displayed on the road one-half mile southeast of Hemlock and in the ravine at Glenville. It also appears in all of the ravines on both sides of Conesus lake in the vicinity of McPherson point.

Fossils are exceedingly rare in the Middlesex shale. The following occur:

Plant remains
Fish remains
Conodonts
Sandbergeroceras syngonum *Clarke*
Ontaria suborbicularis (*Hall*)

CASHAQUA SHALE

The black shales are succeeded by nearly 200 feet of light colored bluish gray or olive shale, in which thin flags occur occasionally, and a few thin layers of black shale are interstratified. Calcareous concretions, and thin concretionary layers, continuous for but a short distance, are common in the higher portion of the formation.

Occupying a position between two heavy beds of black shale it is easily recognized by its lighter color and peculiar structure, wherever it is exposed, from Seneca lake to Lake Erie, and its peculiar and interesting fauna has made it the subject of careful study, the results of which, with a list of its fossils, may be found in State Museum Bulletin 63 and Memoir 6.

The Cashaqua beds are abundantly displayed in a very large number of ravines on these quadrangles. Among the more favorable and accessible exposures are the upper beds of Whetstone creek two miles west of Honeoye and the lower along the road half a mile southeast of Hemlock; along Canadice outlet above the Glenville mills; in Shurger's glen two and one-half miles west of Hemlock; in all of the large ravines on both sides of Conesus lake, and the upper beds at the mouth of the two large ravines on the east side of the valley half a mile south of the head of the lake.

RHINESTREET BLACK SHALE

The band of black shale that succeeds the Cashaqua shale and has a thickness on these quadrangles of 30 to 40 feet, was formerly known as the "upper black band." It was designated as above in State Museum Bulletin 63, from its exposure at the locality in the Canandaigua lake valley known as Rhinestreet, where it is 22 to 25 feet thick. It increases rapidly toward the west and on Lake Erie is 150 to 185 feet thick.

It is a well-defined band of slaty, bituminous black shale between formations of much lighter color, and, having greater power of resistance to erosive forces than those beds, it frequently produces cascades in the ravines along the line of outcrop.

It appears at most of the exposures of the upper Cashaqua beds in these quadrangles. It is seen to great advantage in the walls of the amphitheatre in the ravine of Whetstone creek half a mile south of the Honeoye-Hemlock road. It is also well exposed in Shurger's gully two and one-half miles west of Hemlock; in the two ravines half a mile south of the head of Conesus lake, east

side, and in a Delaware, Lackawanna & Western Railroad cut, at the west line of the Wayland quadrangle.

The fauna of the Rhinestreet shale is very limited. The following list shows the species that have been identified from it:

Polygnathus dubius *Hinde*
Prioniodus spicatus *Hinde*
P. erraticus *Hinde*
Palaeoniscus devonicus *Clarke*
Acanthodes pristis *Clarke*
Spathiocaris emersoni *Clarke*
Lunulicardium velatum *Clarke*
Pterochaenia fragilis (*Hall*)
Leptodomus multiplex *Clarke*
Lingula *cf.* ligea
Plant remains are common, sometimes occurring in masses.

HATCH SHALE AND FLAGS

Next above the Rhinestreet shale there is a partial return to the conditions in the Cashaqua beds below, though the light shales are harder and less calcareous, and flags and thin sandstones are more frequent. A few bands of black shale are interbedded, but on the whole the principal lithologic difference between this formation and Cashaqua shale is in the proportion of sandy sediment, which is considerably larger in these beds and increases upward to the top, where they are succeeded by the Grimes sandstones.

About 200 feet of strata are embraced within this formation, which was named from its abundant exposure on Hatch hill at Naples, Ontario county. There are many small exposures of these rocks in fields and ravines and along the highways, but only a few are sufficiently extensive to afford opportunity for satisfactory examination of them. The best are along the roadside and in a small ravine two miles southwest of Honeoye; in some small gullies on the west side of Canadice lake; along the roadside two miles north of Cemetery hill; in the north ravine near the head of Conesus lake, and the Calabogue ravine at Conesus, where the entire formation may be seen under favorable conditions. In the Canaseraga creek valley the lower part of all the ravines on the east side between West Sparta and Dansville show Hatch shales and flags. They also appear on the west side northward from Cumminsville.

Fossils are very rare here. The softer shales in the lower beds contain a few forms like those found in the Cashaqua. The sandier beds are quite barren except of plant remains. The collector may expect to find:

Manticoceras pattersoni (*Hall*)
Probeloceras lutheri *Clarke*
Lunulicardium ornatum *Hall*
Honeoyea desmata *Clarke*
Buchiola retrostriata (*v. Buch*)
Palaeotrochus praecursor *Clarke*
Bactrites

GRIMES SANDSTONE

This formation is composed principally of even layers of sandstone from six inches to three feet thick, some of which are rather soft and shaly, while others are hard and calcareous. The aggregate thickness is not far from fifty feet.

It appears on the next quadrangle toward the east in the Grimes gully at Naples, where it contains a small brachiopod fauna allied to the Ithaca fauna and other forms not known elsewhere.

Though these sandstones outcrop in many places on the Wayland quadrangle there are very few good exposures of the entire formation.

The entire section is shown in the Calabogue ravine below the lower bridge in the village of Conesus. The sandstones are quite barren of fossils except at the top, where a 14 to 16 inch layer is very hard, calcareous and concretionary and contains large irregularly shaped concretions so frequently as to almost form a continuous layer. It bears a close resemblance to a stratum in this horizon in Tannery gully, Naples, and like that one, contains brachiopod shells quite abundantly, but mostly in so fragmentary condition as to preclude identification.

Entire valves of a small Rhipidomella and Productella spinulicosta occur and loose spines of a larger Productella are abundant. Fragments of Liorhynchus may also be recognized.

The Grimes sandstones may be seen at the Delaware, Lackawanna & Western Railroad culvert in the Culberson gully three and one-half miles north of Dansville, in other ravines and quarries in the east side of the Canaseraga valley, and on the west side at the mouth of the Bradner creek ravine half a mile northwest of Woodville.

GARDEAU FLAGS AND SHALE

Light bluish gray sandstones and flags separated by beds of blue, olive or black shales succeed the Grimes sandstone for about 500 feet. In general stratigraphy this formation is much like the Hatch shale and flags, but many of the sandstones and some of the shale beds are thicker than are seen in that formation. It is the surface rock over a large area on these quadrangles, the drift cover of which, except in a few localities, is quite thin, and field outcrops are frequent. Almost innumerable ravines and small gullies on the hillsides show rock sections embracing some part of the Gardeau beds.

Among the best exposures on these quadrangles are: in Reynold's gulf, three miles north of Springwater; along Calabogue creek above the mill at Conesus; the Culberson ravine above the railroad; the Bradner creek ravine north of Woodville; and at Stones Falls and Stony brook glen south of Dansville.

Fossils are rare, but a few brachiopods known in the Ithaca fauna occur in some of the sandstones, and a few lamellibranchs and cephalopods common in the Cashaqua shales are found in soft shales, especially in the upper part of the formation.

The following is a partial list of the species occurring in the Gardeau beds:

Manticoceras oxy *Clarke*
Palaeotrochus praecursor *Clarke*
Grammysia elliptica *Hall*
Leptodesma robustum *Hall*
Productella lachrymosa *Hall*
P. spinulicosta *Hall*
Ambocoelia umbonata (*Conrad*)
Atrypa hystrix *Hall*
Orthothetes chemungensis *Conrad*
Liorhynchus mesacostalis *Hall*
Hydnoceras tuberosum *Conrad*
Aulopora *sp.*
Crinoid stems

NUNDA SANDSTONE

(Portage sandstone of early reports)

A heavy band of light bluish gray sandstone succeeds the Gardeau flags in central New York. It is a strongly marked feature of the stratigraphy of the region and is of considerable economic value as the source of fine building stone.

The formation is nearly 200 feet thick in the Genesee river section, but thins out toward the west and barely reaches Lake Erie. It is less homogeneous toward the east, some parts becoming shaly, but it is traceable to the Seneca lake valley.

On the Genesee river and farther west fossils, except plant remains, are extremely rare, but on the Wayland quadrangle and eastward, there are found lenticular masses of crinoidal limestone that contain brachiopods and other fossils in large numbers.

Except in the southern part of the Wayland quadrangle, the position of these sandstones is too high to permit of good exposures, but they are well displayed for nearly a mile along the Pittsburg, Shawmut & Northern Railroad two miles southeast of Perkinsville. Extensive quarries on the hill east of Dansville are in these beds, and they have also been quarried on the south face of the hill one and one-half miles north of Perkinsville. Blocks from a fossiliferous lentil at the south end of the hill four miles east of Wayland have been utilized as firestone in that vicinity. Calcareous slabs from this lens, or possibly another one, lie on the north face of the hill one and one-half miles southeast of Wayland.

The fossils contained in these lentils have not been listed, except in the case of the large one on High point on the Naples quadrangle three miles east of this quadrangle, from which 32 species have been obtained. For list, see State Museum Bulletin 63.

WISCOY BEDS

About 200 feet of light and dark shales and soft sandstones that contain a fauna bearing some resemblance to that of the normal Portage and on that account have been considered as a separate formation, succeed the Nunda sandstone on the Genesee river. Though acquiring an increase of sandy material and appearing mainly as a bed of rather soft olive sandstone, on the Wayland quadrangle this formation is readily distinguished from the harder, lighter colored and usually more fossiliferous sandstones and harder shales of the normal Chemung beds by which it is overlain.

There is a small exposure of Wiscoy beds by the side of the Pittsburg & Shawmut Railroad where it crosses the south line of the quadrangle, and a more extensive one from two miles south of Patchenville to the south line of the quadrangle. Crinoid stems, small brachiopods and a small Orthoceras occur here. The large cephalopod Manticoceras oxy Clarke appears occasionally in these beds.

With the increase of sand in the sedimentation toward the east, a few brachiopods which are not found at Wiscoy appear.

CHEMUNG SHALE AND SANDSTONE

About 450 feet of the lower beds of this formation compose the surface rock on the high land in the extreme southern part of the Wayland quadrangle. In lithologic character they are not materially different from the Gardeau beds, except that the sandstones are lighter colored and more micaceous.

Fossils are rare in the lower 300 feet but are in very great abundance in the higher sandstones exposed on this quadrangle. These may be seen to good advantage along the roadside three-fourths of a mile northeast of Loon lake, where the rock is crowded with large brachiopods. Hydnoceras nodosum Hall occurs here also.

The rock lies near the surface over this region and small field exposures are frequent, but there are no extensive outcrops.

DIP

The average dip of the base of the Onondaga limestone between Honeoye Falls and the salt shaft at Livonia is about 33 feet per mile toward the south. On an east and west line, though made variable by frequent undulations of the strata, this limestone is on the whole nearly level.

As all of the formations above the Onondaga up to the Wiscoy shale, except the Stafford limestone and the Rhinestreet black shale, thin out more or less rapidly toward the west, the dip in that direction varies also with the contact line used as a base, but is nowhere appreciable except on careful measurement. The deep and narrow valleys partly occupied by Conesus, Hemlock and Honeoye lakes are blocked at the south ends by enormous beds of gravel, sand and clay which compose a part of the great moraine of the second glacial epoch. The areas intervening between the lakes and the moraine are level beds of rich alluvium. The Genesee river valley in the northwest corner of the Honeoye quadrangle; the Canaseraga valley near Dansville; the bed of a small lake near Wayland and another at South Lima, are of similar character.

A striking exhibition of the force of glacial action occurs in a small amphitheatrical valley of Stony brook at Five Corners, four miles west of Honeoye Falls. The bed rock, Bertie waterlime, is

but slightly exposed, but a very large quantity of Lockport dolomite has been transported southward a distance of at least twelve miles and deposited here. The sloping bank on the east side of the little valley is almost covered by blocks of the brown scraggly rock, some of which are twelve to fifteen feet across and six to eight feet thick. They lie so close together that they present the appearance of a broken escarpment, extending toward the north for 60 to 70 rods.

Large blocks of the dolomite are common in this vicinity and a morainic mass of this rock covers several acres half a mile west of this locality, but is mostly in smaller blocks.

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New York State Museum

JOHN M. CLARKE, Director

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Museum annual reports 1847–date. *All in print to* 1894, 50c *a volume*, 75c *in cloth; 1894–date, sold in sets only; 75c each for octavo volumes; price of quarto volumes on application.*

These reports are made up of the reports of the Director, Geologist, Paleontologist, Botanist and Entomologist, and museum bulletins and memoirs, issued as advance sections of the reports.

Director's annual reports 1904–date.

1904. 138p. 20c.
1905. 102p. 23pl. 30c.
1906. 186p. 41pl. 35c.
1907. 212p. 63pl. 50c.
1908. 234p. 39pl. map. 40c.
1909. 230p. 41pl. 2 maps, 4 charts. *Out of print.*
1910. 280p. il. 42pl. 50c.

These reports cover the reports of the State Geologist and of the State Paleontologist. Bound also with the museum reports of which they form a part.

Geologist's annual reports 1881–date. Rep'ts 1, 3–13, 17–date, 8vo; 2, 14–16, 4to.

In 1898 the paleontologic work of the State was made distinct from the geologic and was reported separately from 1899–1903. The two departments were reunited in 1904, and are now reported in the Director's report.

The annual reports of the original Natural History Survey, 1837–41, are out of print.

Reports 1–4, 1881–84, were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

Separate volumes of the following only are available.

Report	*Price*	*Report*	*Price*	*Report*	*Price*
12 (1892)	$.50	17	$.75	21	$.40
14	.75	18	.75	22	.40
15, 2v.	2	19	.40	23	.45
16	1	20	.50	[*See* Director's annual reports]	

Paleontologist's annual reports 1899–date.

See first note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Those for 1901–3 were issued as bulletins. In 1904 combined with the Director's report.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882–date.

Reports 3–20 bound also with museum reports 40–46, 48–58 of which they form a part. Since 1898 these reports have been issued as bulletins. Reports 3–4, 17 are out of print, other reports with prices are:

Report	Price	Report	Price	Report	Price
1	$.50	11	$.25	19 (Bul. 76)	$.15
2	.30	12	.25	20 (" 97)	.40
5	.25	13	*Free*	21 (" 104)	.25
6	.15	14 (Bul. 23)	.20	22 (" 110)	.25
7	.20	15 (" 31)	.15	23 (" 124)	.75
8	.25	16 (" 36)	.25	24 (" 134)	.35
9	.25	18 (" 64)	.20	25 (" 141)	.35
10	.35			26 (" 147)	.35

Reports 2, 8–12 may also be obtained bound in cloth at 25c each in addition to the price given above.

Botanist's annual reports 1867–date.

Bound also with museum reports 21–date of which they form a part; the first Botanist's report appeared in the 21st museum report and is numbered 21. Reports 21–24, 29, 31–41 were not published separately.

Separate reports for 1871–74, 1876, 1888–98 are out of print. Report for 1899 may be had for 20c; 1900 for 50c. Since 1901 these reports have been issued as bulletins.

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have also been published in volumes 1 and 3 of the 48th (1894) museum report and in volume 1 of the 49th (1895), 51st (1897), 52d (1898), 54th (1900), 55th (1901), in volume 4 of the 56th (1902), in volume 2 of the 57th (1903), in volume 4 of the 58th (1904), in volume 2 of the 59th (1905), in volume 1 of the 60th (1906), in volume 2 of the 61st (1907), 62d (1908), 63d (1909) reports. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and, combined with others more recently prepared, constitute Museum Memoir 4.

Museum bulletins 1887–date. 8vo. *To advance subscribers, $2 a year or $1 a year for division (1) geology, economic geology, paleontology, mineralogy; 50c each for division (2) general zoology, archeology, miscellaneous, (3) botany, (4) entomology.*

Bulletins are grouped in the list on the following pages according to divisions.

The divisions to which bulletins belong are as follows:

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2 Botany	53 Entomology	104 "
3 Economic Geology	54 Botany	105 Botany
4 Mineralogy	55 Archeology	106 Geology
5 Entomology	56 Geology	107 "
6 "	57 Entomology	108 Archeology
7 Economic Geology	58 Mineralogy	109 Entomology
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